

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellants: Jordan J.N. Tang and Arun K. Ghosh

Serial No.: 09/506,988

Filed: February 18, 2000



Art Unit: 1625

Examiner: D. Seaman

For: *"PROTEASE INHIBITORS THAT OVERCOME DRUG RESISTANCE"*

Assistant Commissioner for Patents  
Washington, D.C. 20231

APPEAL BRIEF

Sir:

This is an appeal from the final rejection of claims 1-12 in the Office Action mailed March 8, 2001, in the above-identified patent application. A Notice of Appeal was mailed on July 26, 2001. Submitted with this Appeal Brief are Powers of Attorney by the Assignees of Joint Interest and Revocation of Prior Powers, and Statements under 37 C.F.R. § 3.73 (b). A check in the amount of \$155.00 for the filing of this Appeal Brief for a small entity is also enclosed.

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It is believed that no additional fee is required with this submission. However, should an additional fee be required, the Commissioner is hereby authorized to charge the fee to Deposit Account No. 50-1868.

**(1) REAL PARTY IN INTEREST**

The real parties in interest of this application are the assignees Oklahoma Medical Research Foundation and The Board of Trustees of the University of Illinois.

**(2) RELATED APPEALS AND INTERFERENCES**

There are no related appeals or interferences known to appellant, the undersigned, or appellant's assignee which directly affects, which would be directly affected by, or which would have a bearing on the Board's decision in this appeal.

**(3) STATUS OF CLAIMS ON APPEAL**

The Advisory Action mailed June 25, 2001, indicated that claims 1-12 were rejected. The Examiner stated in the Advisory Action and in a telephone interview with Appellant's representative on September 18, 2001, that the proposed amendments would be entered upon timely submission of an Appeal Brief. Therefore, the status of the claims on appeal is as follows: 1, 2, 4-8, and 10-12 are pending and on appeal. The text of each claim on appeal, as pending, is set forth in an Appendix to this Appeal Brief.

**(4) STATUS OF AMENDMENTS**

An amendment after final rejection was mailed on June 8, 2001. In the Advisory Action mailed June 25, 2001, the Examiner indicated that this amendment would be entered upon the timely submission of a Notice of Appeal and Appeal Brief.

**(5) SUMMARY OF THE INVENTION**

The claims are directed to an aspartic protease inhibitor comprising two or more transition state isosteres (page 5, lines 23-26). The aspartic protease inhibitor may be, for example, an HIV protease inhibitor (page 10, lines 7-31) such as UIC-98-056 (Example 1 and Example 2). The transition state isostere of the inhibitor may be, for example, -CH(OH)-CH<sub>2</sub>- (page 4, lines 27-29) or may contain two other kinds of isosteres substituted in place of -CH(OH)-CH<sub>2</sub>- (claim 6 as originally filed).

The claims are also directed to a method for treating patients infected with a pathogen that expresses an aspartic acid protease (page 12, lines 26-29 and claim 7 as originally filed). The method comprises the oral administration of an aspartic acid protease inhibitor comprising two or more transition-state isosteres (page 12, lines 28-29 and page 5, lines 23-26). The inhibitor may be, for example, an HIV protease inhibitor (page 10, lines 7-31) or UIC-98-056 (Example 1 and Example 2). The transition state isostere may be, for example, -CH(OH)-CH<sub>2</sub>- (page 4, lines 27-29) or may contain two other kinds of isosteres substituted in place of -CH(OH)-CH<sub>2</sub>- (claim 6 as originally filed).

**(6) ISSUES ON APPEAL**

The issue presented on appeal is:

(1) whether claims 1, 2, 4-8, and 10-12 were properly rejected under 35 U.S.C. § 112, first paragraph, as lacking enablement.

**(7) GROUPING OF CLAIMS**

The claims do not stand or fall together. The claims can be grouped as follows: (1) claim 1, (2) claims 2 and 6, (3) claims 4-5 (4) claim 7, and (4) 8, 10-12. Claim 1 is directed towards a protease inhibitor comprising two or more isosteres. Claims 2 and 6 are directed to the inhibitors as comprising isosteres such as  $-\text{CH}(\text{OH})-\text{CH}_2-$ , or substitutions thereof. Claims 4-5 are directed to inhibitors as UIC-98-056, that may inhibit proteases such as aspartic acid proteases, for example HIV protease. Claim 7 is directed towards a method to administer a two or more isostere harboring protease inhibitor to a person infected with a pathogen expressing a protease. Claims 8 and 12 are directed to a method wherein the isosteres of the administered inhibitor are further defined and may comprise isosteres such as  $-\text{CH}(\text{OH})-\text{CH}_2-$ , or substitutions thereof. Claims 10 and 11 are directed to defining the inhibitor to be administered in a method such that the inhibitor can be UIC-98-056 and may inhibit aspartic proteases such as HIV protease. Reasons for this grouping and arguments for the separate patentability of these groups of claims are provided below.

**(8) ARGUMENTS**

**(a) The Claimed Invention**

Aspartyl proteases have been widely studied and shown to be involved in the regulation of many proteins. These studies have incorporated genetic and biochemical, as well as structural observations. The implications drawn from these studies are that aspartyl acid proteases possess very similar active core structures and therefore exhibit a common mechanism of catalysis. Drug inhibitors that possess a "module" (isostere) that mimics the scissile bond normally cleaved by

the core structure of the aspartyl protease were designed based on the correlation between structure and mechanism. The inhibitor's ability to mimic the scissile bond and align its peptide backbone with "subsites" in the core allows it to tightly bind in the core pocket. This mechanism is analogous to a "lock and key". Commercial inhibitors that harbor the isostere and thereby bind tightly, have been widely prescribed and used by patients to treat diseases such as AIDS by inhibiting aspartyl protease activity that is central to virus activity and replication. In fact, these inhibitors have been so widely used that there is an increased pressure on the aspartyl proteases, to which the inhibitor's interact and inhibit, to mutate so that they are no longer recognized by the single isostere harboring inhibitor(s). The appellants have discovered aspartyl protease inhibitors containing two or more isosteres have an increased efficacy in inhibiting the activity of such proteases by decreasing the protease's ability to become resistant to the inhibitory mechanism. The presence of two or more isosteres, while inhibiting the protease, also severely restricts or limits the ability of the protease to mutate to a form no longer recognizable by the compound.

The inhibitor (the "key") is structurally determined based upon the structure of the core (the "lock") of the aspartic protease that is required for normal protease activity. The appellants disclose in the specification that transition-state isosteres mimic a substrate peptide with a hydrolyzable site. The correct orientation of the isostere(s) within the core of the protease aids in determining binding and inhibitory efficacy. The proper orientation of the isostere(s) and the alignment of surrounding residues with subsites in the core, thereby providing tight binding, are precluded by the structure of the core of the protease. However, as stated above, based upon

extensive analyses, the core of aspartyl proteases are structurally similar and exhibit common mechanisms of catalysis. Therefore the structural features of the claimed inhibitors are clearly defined by the core structure of the well-studied aspartyl protease family of enzymes. These findings provide the basis for the claimed aspartic protease inhibitor. The appellants have demonstrated how to design, make and test multi-isostere harboring aspartic protease inhibitors.

Appellants have discovered an increased efficacy of aspartyl protease activity inhibition and resistance by protease inhibitors harboring two or more isosteres. The appellants present in the specification the conceptual framework from which the Examples and data are derived. Conceptually, the invention revolves around the idea that enzymes, when consistently barraged with inhibitors, are posed with the difficult task of mutating, due to evolutionary pressure, in order to resist the inhibitor and ensure optimal activity. This task becomes even more difficult when more than just one mutation is required for resistance to the particular inhibitor. Example one and Figure III describe in detail and outline, respectively, the procedure for synthesizing a two isostere aspartyl protease inhibitor (HIV protease inhibitor UIC-98-056). The protease that encounters such an inhibitor will generally have to mutate at, at least, two residue positions to overcome the presence of two isosteres within its core pocket. Multi-isostere harboring inhibitors align in the substrate binding site in two or more different ways, presenting different side chains for each alignment. Therefore, not only are the isosteres contributing to binding, they play a role in adjusting the interacting side chains of the inhibitor so that they also contribute to the overall binding. This mechanism makes it very unlikely that any one mutation in the protease can prevent binding of the inhibitor. The remarkable and surprising ability of UIC-98-

056 (two-isostere inhibitor) to withstand the development of HIV protease mutation-resistance is presented in Example two, Table II, and Figure four. The difference in the average increases in  $K_i$  for the resistant mutant HIV proteases, presented in Table II, over the wild type enzyme in the presence of inhibitor is truly unique and has not been previously reported. The average fold increase of resistance for the mutant proteases over wild type, in the presence of UIC-98-056, was only 1.45-fold (with 9 of the 10  $K_i$  values unchanged from wild type), compared to 15.12-fold, 18.89-fold, and 10.76-fold for the commercially available drugs ritonavir, indinavir, and saquinavir, respectively. It should also be pointed out that if one were to disregard the fold increase for the I84V mutation, which is still less significant than the three commercially available drugs, there would actually be a decrease in average  $K_i$  for the nine remaining mutant proteases in the presence of UC-98-056 (0.56-fold).

The appellants also disclose pharmaceutical methods and formulations for the administration of the claimed inhibitors in light of those aspartyl protease inhibitors that are commercially available. For example, the treatment of HIV infected individuals using aspartyl protease inhibitors is well documented as disclosed in the specification (page 12, lines 26, to page 13, line 6). Similar types of methods and formulations may be used to administer the presently claimed inhibitors. The regimen and choice of drug and drug combinations are usually under the discretion of a physician and are dependent upon the resistance genotype and phenotype of the HIV strain.

**(b) Rejections Under 35 U.S.C. § 112**

Claims 1, 2, 4-8, and 10-12 were rejected under 35 U.S.C. § 112, first paragraph, as not being enabled by the specification based on:

a) the prior art demonstrates the criticality of the choice and amount of compound and conditions effective to inhibit the protease; and

b) the claims encompass an unlimited number of types of compounds.

These rejections are factually, and legally, incorrect.

i. The Legal Standard under 35 U.S.C. § 112, first paragraph

The Court of Appeals for the Federal Circuit (CAFC) has described the legal standard for enablement under § 112, first paragraph, as whether one skilled in the art could make and use the claimed invention from the disclosures in the patent coupled with information known in the art without undue experimentation (*See, e.g., Genentech, Inc. v. Novo Nordisk A/S*, 108 F.3d at 165, 42 USPQ2d at 1004 (quoting *In re Wright*, 999 F.2d 1557, 1561, 27 USPQ2d 1510, 1513 (Fed. Cir. 1993); *See also In re Fisher*, 427 F.2d at 839, 166 USPQ at 24; *United States v. Telectronics, Inc.*, 857 F.2d 778 (Fed. Cir. 1988); *In re Stephens*, 529 F.2d 1343 (CCPA 1976)). The fact that experimentation may be complex does not necessarily make it undue, if the art typically engages in such experimentation (*M.I.T. v. A.B. Fortia*, 774 F.2d 1104 (Fed. Cir. 1985)). In addition, as affirmed by the Court in *Spectra-Physics, Inc. v. Coherent, Inc.*, 827 F.2d 1524 (Fed. Cir. 1987), a patent need not teach, and preferably omits, what is well known in the art.



Whether the disclosure is enabling is a legal conclusion based upon several underlying factual inquiries. See *In re Wands*, 858 F.2d 731, 735, 736-737, 8 USPQ2d 1400, 1402, 1404 (Fed. Cir. 1988). As set forth in *Wands*, the factors to be considered in determining whether a claimed invention is enabled throughout its scope without undue experimentation include the quantity of experimentation necessary, the amount of direction or guidance presented, the presence or absence of working examples, the nature of the invention, the state of the prior art, the relative skill of those in the art, the predictability or unpredictability of the art, and the breadth of the claims. In cases that involve unpredictable factors, "the scope of the enablement obviously varies inversely with the degree of unpredictability of the factors involved." *In re Fisher*, 427 F.2d 833, 839, 166 USPQ 18, 24 (CCPA 1970). The fact that some experimentation is necessary does not preclude enablement; what is required is that the amount of experimentation 'must not be unduly extensive.' *Atlas Powder Co., v. E.I. DuPont De Nemours & Co.*, 750 F.2d 1569, 1576, 224 USPQ 409, 413 (Fed. Cir. 1984).

ii. Factual Analysis of Claims 1, 2, 4-8, and 10-12 under 35 U.S.C. § 112, first paragraph

The similarity of the core structure of the aspartyl proteases drives the common mechanistic features of enzymatic cleavage of proteins and polypeptide bonds within this class of proteins. The claimed aspartyl protease inhibitors are described in the specification. The process of making such an inhibitor that harbors two or more isosteres and assays used to measure its inhibitory effects on various forms of HIV protease are provided within the examples. The claimed invention is based upon the detailed structural studies of the catalytic core of the HIV protease and other aspartyl proteases. These studies are outlined in the specification.

The *de novo* design of protease inhibiting compounds requires one to characterize the target protease as a member of a particular class, for example serine, cysteine, metallo, or aspartyl class ( the aspartyl class being one the most extensively characterized ). As stated on page 3, line 29, to page 4, line 3 of the specification, the aspartic proteases share a common active-site structure ( the "core" ) and catalytic mechanism. Designing an inhibitor relies upon this essential information because it is the activity of the core of the protease that is being inhibited. Once the core structure and/or catalytic mechanism has been elucidated, the design and construction of an inhibitor harboring two or more isosteres can be accomplished without undue experimentation, as provided for in the presently claimed invention. The design of inhibitors against aspartyl proteases, such as renin and HIV protease, has been demonstrated based upon this principal. Aspartyl protease inhibitors retain similar structural and physical properties because of their stereospecificity for a class of proteases with similar active pockets to which they bind and interact. Even if one was not familiar with the structural properties of a targeted enzyme, the amino acid sequence of the enzyme can be easily inserted into any number of commercially available computer programs and the structural features of the enzyme determined. The structure of the inhibitor is clearly limited based on the requirement for it to bind in the core of the targeted enzyme.

The appellants have provided, in the specification, examples and descriptions of isostere harboring aspartyl protease inhibitors, their standard modes of administration, as well as their formulation. 35 U.S.C. § 112, first paragraph, is satisfied in view of the combination of the art recognizing standard modes of making, formulating, and administering single isostere inhibitors;

and the Example of making a two isostere inhibitor provided in the specification. *In re Johnson*, 282 F.2d 370, 373, 127 USPQ 216, 219 (CCPA 1960); *In re Hitchings*, 342 F.2d 80, 87, 144 USPQ 637, 643 (CCPA 1965). The construction of the claimed inhibitors would not require undue experimentation based upon: 1) the appellant's disclosed detailed method of making and testing the two isostere inhibitor; and 2) the structural characterization of the cores of aspartyl proteases, from which the presently claimed invention relies upon.

iii. The Examiner has completely failed to individually examine the dependent claims.

It is well established that each claim must be separately examined for patentability. It is not enough, as here, to look at a single independent claim and reject all of the claims. No art or rationale has been presented why the subject matter of claims 2 and 8, where the specific formula for the claimed isostere is define, is not definite and enabled.

The same argument is applicabel to claims 6 and 12, where the specific formula of the isostere of claims 2 and 8, respectively, is substituted with two other isosteres.

The HIV protease aspartic acid site is well characterized. Several inhibitors are used clinically that consist of a single isostere that binds tightly to this site. No art or rational has been presented why the subject matter of claims 3 and 10 is not definite and enabled.

With regard to claims 5 and 11, drawn to a specific compound, the examiner indicates that this compound might be enabled, yet it is included under the rejection under 35 U.S.C. §112, first paragraph, as overly broad and non-enabled.

As stated in the MANUAL OF PATENT EXAMINING PROCEDURE §2164.04 (7th ed. 1998), *citing In re Wright*, 999 F.2d 1557, 1562 (Fed. Cir. 1993), the examiner has the initial burden to establish a reasonable basis to question the enablement of the application.

A specification disclosure which contains a teaching of the manner and process of making and using an invention in terms which correspond in scope to those used in describing and defining the subject matter sought to be patented **must be taken as being in compliance with the enablement requirement** of 35 U.S.C. § 112, first paragraph, unless there is a reason to doubt the objective truth of the statements contained therein which must be relied on for enabling support.

*Id.* at § 2164.05 (emphasis added).

In this case, the examiner is relying on conclusory statements without putting forth specific reasons describing why the claims are not enabled by the specification. The patent examiner cannot just assert that the application is not enabled. As stated in *In re Marzocchi* at 439 F.2d 220 (CCPA 1971:

[I]t is incumbent upon the Patent Office, whenever a rejection on this basis is made [, enablement under § 112, first paragraph], to explain *why* it doubts the truth or accuracy of any statement in a supporting disclosure **and to back up assertions of its own with acceptable evidence or reasoning which is inconsistent with the contested statement.** Otherwise, there would be no need for the Appellant to go to the trouble and expense of supporting his presumptively accurate disclosure.

Id. at 224.

The MPEP instructs examiners to make specific findings of *facts* to rebut Appellants' presumption and "specifically identify what information is missing and why one of skill in the art could not supply the information without undue experimentation." MPEP at § 2164.05. The examiner should provide references to support a *prima facie* case of lack of enablement. Id.

The examiner has failed to meet the legal burden in this case.

## **(9) SUMMARY AND CONCLUSION**

As stated in the specification, many types of isosteres are well known and their mechanism of action is predictable based upon, for example, the fact that "a single transition-state isostere is used in an inhibitor since it mimics a substrate peptide with a single hydrolysis site". The isostere harboring drugs that have proven to be clinically effective and described for aspartyl protease inhibition, provide further evidence that isostere dependent inhibition is well

known in the art. Therefore one of skill in the art would be very familiar with isostere structures and the processes to synthesize them.

The Examples explicitly outline a detailed procedure for making a multi-isostere harboring inhibitor (UIC-98-056). The construction of inhibitors harboring more than two isosteres would not require undue experimentation based upon the appellant's disclosed detailed method of making and testing the two isostere inhibitor (UIC-98-056), and the recognized art from which the presently claimed invention relies upon. The recognized art details the core structure of aspartyl proteases and mechanism of action. This art directly enables the scientific community to classify these proteases into one group. Based upon the common core structure of this particular class of proteases, to which the two or more isostere containing inhibitors bind and inhibit activity, the inhibitors are structurally defined in terms of size, physical and chemical properties. In view of the foregoing discussion, Appellant's submit that the presently claimed invention is enabled for an aspartic protease harboring two or more isosteres, and a method for treating a patient infected with a pathogen expressing an aspartic acid protease administering the claimed protease inhibitor.

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**APPEAL BRIEF**

For the foregoing reasons, Appellant's submit that the claims 1, 2, 4-8, and 9-12 are patentable.

Respectfully submitted,

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Date: September 26, 2001

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Date: September 26, 2001

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Patrea L. Pabst

**Appendix: Claims On Appeal**

- Amended* 1. (Amended) An aspartic acid protease inhibitor comprising two or more transition-state isosteres.
- II* 2. The inhibitor of claim 1 wherein the transition-state isostere is  $-\text{CH}(\text{OH})-\text{CH}_2-$ .
- III* 4. (Amended) The composition of claim 1 wherein the aspartic acid protease inhibitor is an HIV protease inhibitor.
- IV* 5. The inhibitor of claim 1 which is UIC-98-056.
- II* 6. The inhibitor of claim 2 wherein the  $\text{CH}(\text{OH})-\text{CH}_2$  is substituted with two other kinds of isosteres.
- IV* 7. (Amended) A method for treating a patient infected with a pathogen expressing an aspartic acid protease comprising the oral administration of an aspartic acid protease inhibitor comprising two or more transition-state isosteres.
8. The method of claim 7 wherein the transition-state isostere is  $\text{CH}(\text{OH})-\text{CH}_2-$ .
10. (Amended) The method of claim 7 wherein the protease inhibitor inhibits HIV protease.
11. The method of claim 10 wherein the inhibitor is UIC-98-056.
12. The method of claim 8 wherein the  $\text{CH}(\text{OH})-\text{CH}_2$  is substituted with two other kinds of isosteres.



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